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COMPLETE SPECIFICATION

A Process for the Manufacture of Glasses having one or more Components

We, CARL-ZEISS-STIFTUNG, a Foundation established under the Laws of Germany, of Heidenheim a.d. Brenz, Wurttemberg, Germany, trading as JENAER GLASWERK SCHOTT & GEN., do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention concerns a process relating to the manufacture of glasses having one or more components and differs fundamentally from the known melting processes employed in the manufacture of glass.

According to a known process, glasses are melted in a pot furnace or in a tank, i.e. in refractory containers. With such a process, the chemical and physical homogenisation is effected by the resulting common melt and the subsequent refining process of the total glass mass. The homogeneity of a glass achieved with such process is very great.

The level of the melting temperature, however, is restricted by the softening temperature of the crucibles used and their capacity for withstanding the chemical action of the glass melt. Since relatively large amounts of glass are usually melted, a rapid cooling of the glass mass is not possible, so that the glass remains for a very long time in a temperature range at which there is a danger of crystallisation. Glasses showing a particular tendency to crystallisation cannot be melted in accordance with known processes, because they would completely crystallise.

The object of the present invention is to obviate the aforesaid disadvantage and to this end consists essentially in that the component materials of the glass are fed within the flame of a burner, are melted therein and the molten glass is collected by a, preferably rotating, member underneath the burner. The materials to be used for the glass are preferably fed together with the oxidising gases through the interior of a burner into the flame.

According to a further feature of the invention, the distance between the burner outlet and that surface of the collecting member facing the said outlet is adjustable. The effect which can be obtained in this manner is that the surface of the member can be constantly maintained at a temperature below the crystallisation temperature of the molten glass, but not below the transformation temperature.

The process according to the invention offers the very important advantage that the height of the melting temperature is not limited by the thermal or chemical resistance of a melting crucible, but only by the flame temperature.

The process according to the invention is adapted to be used both with single-component and multi-component glasses. With multi-component glasses, it is advisable for the initial materials of the glass to be pretreated prior to introduction into the flame. The simplest pretreatment consists in the initial materials of the glass being powdered and mixed. It is also expedient to frit and grind the said initial materials before being introduced into the flame. Another possible method of obtaining a good mixture prior to melting consists in that the glass materials are dissolved. The solutions of the separate components are mixed and the said components are then jointly precipitated from the solutions.

When using the process according to the invention, it is also necessary to take into account the following. It is known that glass melts are subject to selective surface vaporisation prior to, during and after their formation. For example, a considerable amount of boric acid or alkali oxides are vaporised, even after the glass is formed. However, the selective vaporisation causes inhomogenity, this being largely compensated for by diffusion or convection with the known melting processes carried out in pots or tanks. Such a compensation is not however possible when carrying out the process according to the invention,

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In order to overcome this disadvantage, according to the invention, the individual components of the mixture of the initial materials of the glass are so chosen that the vapour pressure thereof at the glass temperature is the same or substantially the same for all components.

If the vapour pressures and also the melting temperatures of the individual components from which a glass is to be melted should differ very considerably from one another, then the disadvantages which would be caused by a large selective vaporisation can be largely avoided according to the invention by bonding the separate raw materials in a frit prior to melting. This frit can consist of a vitreous substance, a eutectice mixture, a eutectic melt or of two or more substances sintered together.

The invention will be more fully explained by reference to a number of embodiments and also with reference to the accompanying drawing which shows diagrammatically and by way of example one apparatus for carrying the process according to the invention into effect.

The burner 1 is supplied with hydrogen through the outer tube 2 and with oxygen through the inner tube 3. The initial materials of the glass to be produced, for example, mixed in powder form, are supplied together with the oxygen, so that these materials pass into the hottest part of the flame 4, where they are melted, and the molten glass drops down or flows in liquid form on to that surface of a collecting member 5 which faces the burner outlet and forms a homogeneous glass element thereon; the member 5 consists of chamotte or other refractory material.

In order to be able to control the cooling speed and to arrange that the surface of the member 5 is always at a temperature which is lower than the crystallisation temperature but not lower than the transformation temperature the distance between the burner outlet 6 and the member 5 is adapted to be regulated.

Furthermore, according to the invention, a supplementary adjustment of the temperature of the member 5 and thus of the glass element to be formed is to be recommended, this being achieved by separate and preferably electrical heating of the member 5.

The member 5 is movable transversely inside a tube 7 acting as a housing, so that regulation of the temperature is also possible by this means.

Conversely, the walls of the housing can also be constructed so as to be movable, whereby they can be arranged closer to or further away from the member 5 and thereby influence the temperature of the member 5.

In order to produce a uniform development of the glass element to be melted, the member 5 is rotated about its longitudinal axis while the process is being carried into effect.

For example, if a glass having the constituents CaO, Al_2O_3, P_2O_5 and MgO is to be melted by the process according to the invention, the initial materials of the glass must be subjected to a pretreatment, since they have very different melting temperatures and vapour pressures. For example, P_2O_5 vaporises very strongly at a high flame temperature and only extremely small residues of this material are left in the substance.

According to the invention, therefore, two frits are produced:—

1. Eutectic of Al_2O_3 and CaO in the ratio of 50:50. It produces a melting point of 1395° C.

2. Frit consisting of MgO and P_2O_5 in the ratio 36.2:63.8. It gives a melting point of 1383° C. It is advisable for the mixture of the two substances to be initially heat-treated at relatively low temperatures in the region of 150° C. and only then for the temperature to be raised slowly to 600° C.

The said eutectic and the frit have practically the same melting temperatures and vapour pressures, so that glasses consisting thereof in a carefully mixed condition can be melted by the process according to the invention without relatively large losses of P_2O_5.

What we claim is:—

1. A process for the manufacture of glasses having one or more components, wherein the initial materials of the glass are introduced into the interior of a flame, preferably together with the oxidising gases, through the interior of a burner, are melted within said flame and the molten glass is collected by a preferably rotating member arranged underneath the burner.

2. Process according to Claim 1, wherein the distance between the burner outlet and that surface of the member which faces the burner outlet is adjustable.

3. Process according to Claims 1 and 2, wherein the burner and the collecting member are arranged inside a housing, preferably of tubular form.

4. Process according to Claim 3, wherein the spacing between the inside walls of the housing and the member is adjustable whereby the temperature can be controlled.

5. Process according to Claims 1 to 4, wherein the temperature of the member is controlled by a supplementary and preferably electrical heating arrangement.

6. Process according to Claims 1 to 5, wherein the initial materials of the glass are supplied in powder form.

7. Process according to Claims 1 to 6, wherein the initial materials of the glass are fritted and ground prior to being introduced into the flame.

8. Process according to Claims 1 to 7, wherein the initial materials of the glass are dissolved prior to introduction into the flame, the solutions of the separate components being mixed and the components jointly precipitated from the solutions.

9. Process according to Claims 1 to 8, wherein the individual components of the initial materials of the glass are so chosen that their vapour pressure at the melting temperature is the same or substantially the same.

10. Process according to Claims 1 to 9, wherein the adaptation of the melting temperatures and vapour pressures is effected by the initial materials of the glass being first of all mixed in groups in suitable proportions and initially fritted to form eutectic mixtures or eutectic melts or are initially sintered as chemically or physically bonded mixtures, and the two or more initially fritted or initially sintered groups are mixed prior to introduction into the flame and if necessary are sintered together.

11. The improved process for the manufacture of glasses having one or more components substantially as herein described with reference to the accompanying drawing.

12. A glass when produced by a process as herein claimed.

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1 SHEET

This drawing is a reproduction of the Original on a reduced scale.